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Two New Species of Hydrobiid Snails of the Genus *Marstonia* from Alabama and Georgia

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Abstract: Two new species of *Marstonia* (Hydrobiidae, Nymphophilinae) are described. *Marstonia gaddisorum* sp. nov. is found in a spring in the Oconee River basis in central Georgia. *Marstonia angulobasis* sp. nov. is found in isolated sections of the Paint Rock River in northern Alabama. Their relationships within the genus *Marstonia* are discussed.

INTRODUCTION

Recent surveys for freshwater snails along various rivers in the southeastern United States have yielded a number of undescribed species. The two species of hydrobiids described below occur in very restricted habitats, and apparently they have very restricted distributions within their particular drainage systems. One is a small species and the other is a very small species. Because of their restricted deployment and their small sizes it is not surprising that they had been overlooked in previous surveys. They belong to *Marstonia* Baker, 1926, a genus that has undergone rather extensive speciation in the southeastern United States (Thompson, 1977). Hershler (1994) reviewed the species, which were at the time placed in *Pyrgulopsis*. An additional species was described from the Coosa River in Alabama (Thompson, 1995). *Marstonia* was most recently reviewed by Thompson and Hershler (2002). It includes twelve species in addition to the two described herein.

The abbreviation UF used to designate the depository for specimens signifies the Florida Museum of Natural History, University of Florida.

Marstonia F. C. Baker, 1926

Type species: *Amnicola lustrica* Pilsbry, 1890.

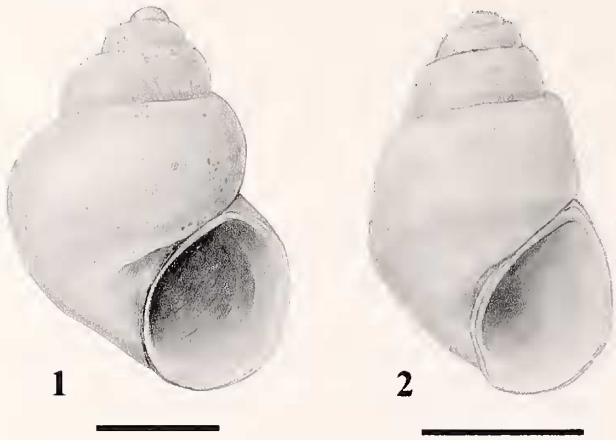
Other included species: *Marstonia agarhecta* Thompson, 1970; *Marstonia arga* Thompson, 1977; *Marstonia castor* Thompson, 1977; *Marstonia comalensis* (Pilsbry & Ferriss, 1906) (originally *Amnicola comalensis* Pilsbry & Ferriss, 1906); *Marstonia halcyon* Thompson, 1977, *Marstonia hershleri* (Thompson, 1995) (originally *Pyrgulopsis hershleri* Thompson, 1995); *Marstonia letsoni* (Walker, 1901) (originally *Amnicola letsoni* Walker, 1901); *Marstonia ogmorhaphe* Thompson, 1977; *Marstonia olivacea* (Pilsbry, 1895) (originally *Amnicola olivacea* Pilsbry, 1895); *Marstonia ozarkensis* (Hinkley, 1915) (originally *Pyrgulopsis ozarkensis* Hinkley, 1915); *Marstonia pachyta* Thompson, 1977; *Marstonia scalariformis* (Wolf, 1869) (originally *Pyrgula scalariformis* Wolf, 1869).

Marstonia gaddisorum sp. nov.

Diagnosis: Shell moderate-sized for the genus; up to 3.5 mm long; broadly ovate conical in shape, with up to 4.5 whorls that are uniformly rounded and are separated by a deeply impressed suture; openly umbilicate; peristome complete across parietal margin. Penis simple, nearly uniformly wide and with a single gland located on the terminal lobe. Penis filament extending beyond terminal lobe.

Shell (Figures 1, 3–8): Light gray with a yellowish tinge. Small, 2.8–3.5 mm in length; broadly conical-ovate in shape; 0.68–0.77 times as wide as high. Shell wall moderately thin (Figure 8), about 60 μm thick at periphery of last whorl. Whorls 4.1–4.5. Protoconch consisting of 1.5 rounded, protruding whorls which are weakly but clearly demarcated from the teleoconch. Whorls regularly increasing in size; first embryonic whorl 0.26–0.28 mm in diameter perpendicular to initial suture; first half whorl sculptured with coarse granular scales. Teleoconch whorls regularly increasing in size, uniformly rounded with a deeply impressed suture. Sculpture consisting of fine incremental striations that are continuous from suture to base; spiral sculpture absent. Umbilicus open and unobstructed by peristome. Aperture oblong-ovate in shape; 0.78–0.91 times as wide as high; 0.40–0.45 times shell length; 0.48–0.57 times shell width; peristome complete across parietal margin; solute from previous whorl, slightly thickened along parietal wall and posterior corned, unreflected; straight in lateral profile. Plane of aperture in lateral profile prosocline at angle of 17–22° to shell axis (Figure 7).

Operculum (Figure 22): Operculum paucispiral, membranous, hyaline, light amber in color; broadly ovate in shape with a convex parietal margin and a bluntly pointed apex. Nucleus large, sub-central. Attachment scar extend-



Figures 1, 2. Holotypes of *Marstonia*. Figure 1. ***Marstonia gaddisorum* sp. nov.** (UF 266265). Figure 2. ***Marstonia angulobasis* sp. nov.** (UF 263300). Scale bars = 1 mm.

ing through the nucleus. Ventral callus very weak. Outer surface bearing a few weak growth striation.

Radula: N = 2. Central tooth (Figure 16) elongate-rectangular in shape, lateral angle well developed, basal process narrow, dorsal edge deeply indented; mesocone pointed, with 4 ectocones on each side; lateral process of tooth with a single well developed and 1–2 additional weakly developed basocones. Lateral tooth with 2-1-4 cusps. Inner marginal tooth with 21 cusps. Outer marginal with about 8–10 short acuminate cusps.

Animal: The tip of the snout is gray. The head-nape is darker gray, which fades into light gray posteriorly and on the sides of the head-foot. The tentacles are marked with four or five diffuse dark stripes of concentrated melanophores that continue the length of the tentacle. The stripes are separated by light gray zones that are about as wide as the dark stripes and continue to a light gray path at the tip. The mantle collar bears a nearly black saddle heavily pigmented with melanophores. The saddle bears two dark arms that extend posteriorly to the stomach and lie along either side of the gill. The pallial gonoduct also is overlain by a similar dark longitudinal zone, as is the digestive gland. The ctenidium consists of 23–26 lamellae (n = 4).

Male (Figure 21): The gray penis is stout, and almost rectangular in shape. It terminates along its mesad margin in a rather stout, blunt apical lobe that bears a single, relatively large, rounded apocrine gland. The laterad margin of the penis bears a slender filament that is about half again the length of the apical lobe. The filament is covered throughout most of its length by a second apocrine gland. The vas deferens is relatively slender and lies along the laterad margin. It is slightly convoluted along basal half.

Female (Figure 23): The bursa copulatrix is long, narrow and horizontal, hardly distinguishable from its short duct. It joins the oviduct by a short duct anterior to the pallial wall. The bursa copulatrix is imbedded within the albumen gland along the anterior first half of its length; the posterior half is impressed into the mesad surface of the albumen gland, but is exposed and slightly overlaps the posterior end. The oviduct forms a single vertical coil beside the albumen gland. The seminal receptacle is relatively large and uniform. It lies parallel to and near the middle of the ventral edge of the albumen gland.

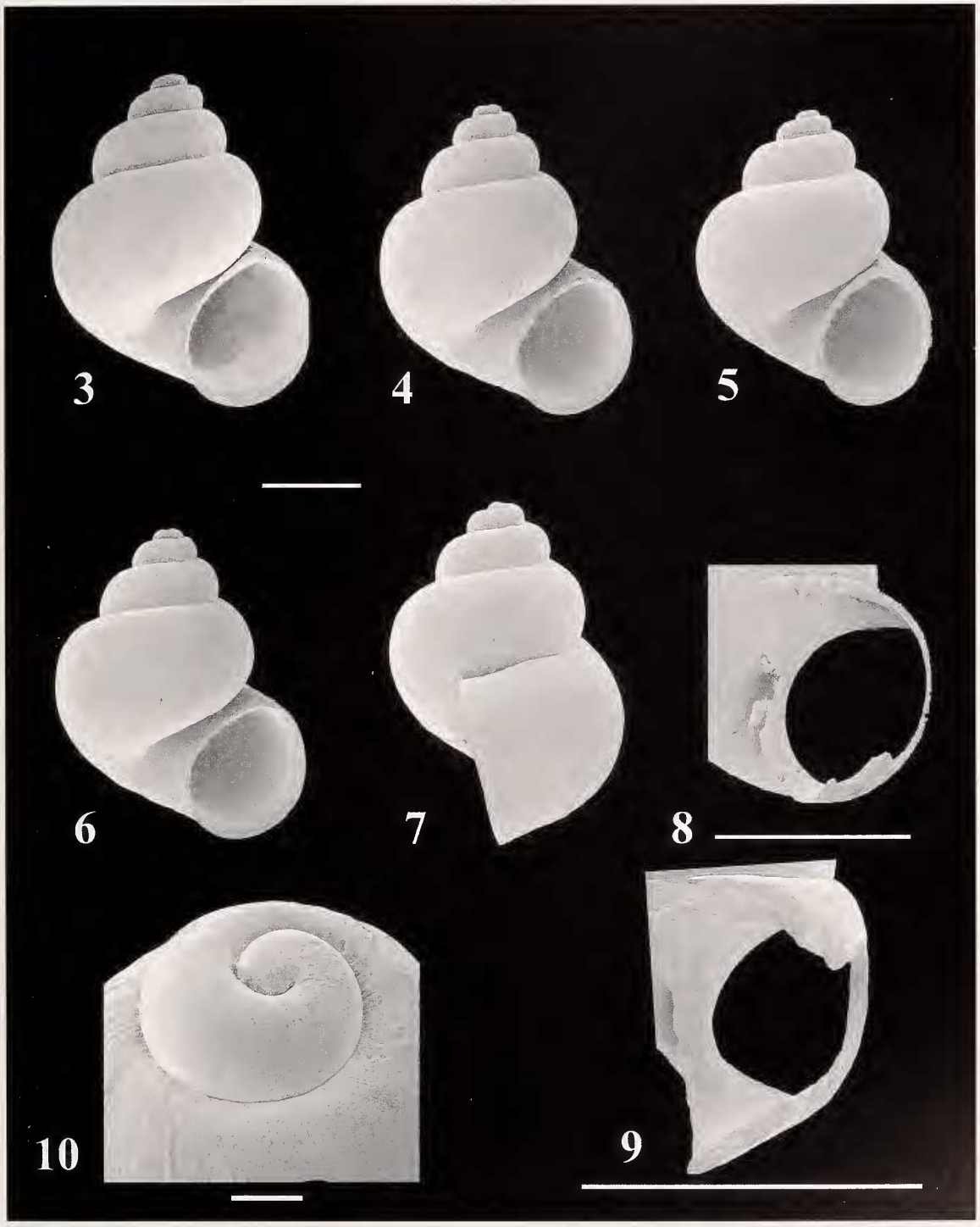
Type locality: GEORGIA, Laurens County, Rock Springs; 32°24.2′N, 82°49.0′W. Holotype: UF 266265; collected 10 October, 1996 by Fred G. Thompson and Elizabeth L. Mihalcik. Paratypes: UF 267632 (ca. 1000), UF 306538 (SEM shell specimens); same data as the holotype. Other specimens: UF 266266; same data as the holotype (anatomical specimens preserved in 70% ethanol).

Rock Springs is located along the west side of the Oconee River, about 9 miles (ca. 14.5 km) southeast of Dublin. It is reached by driving ca. 1.5 miles (2.4 km) southeast of the intersection of Georgia Hwy. 19 and Rock Spring Road, and then 0.7 miles (1.1 km) east on Lucian Drive, which ends at the spring. The spring is partially impounded by an earthen dam along its north side to form a large swimming pool. The spring is on private property. Access was provided by Richard Marshall Gaddis.

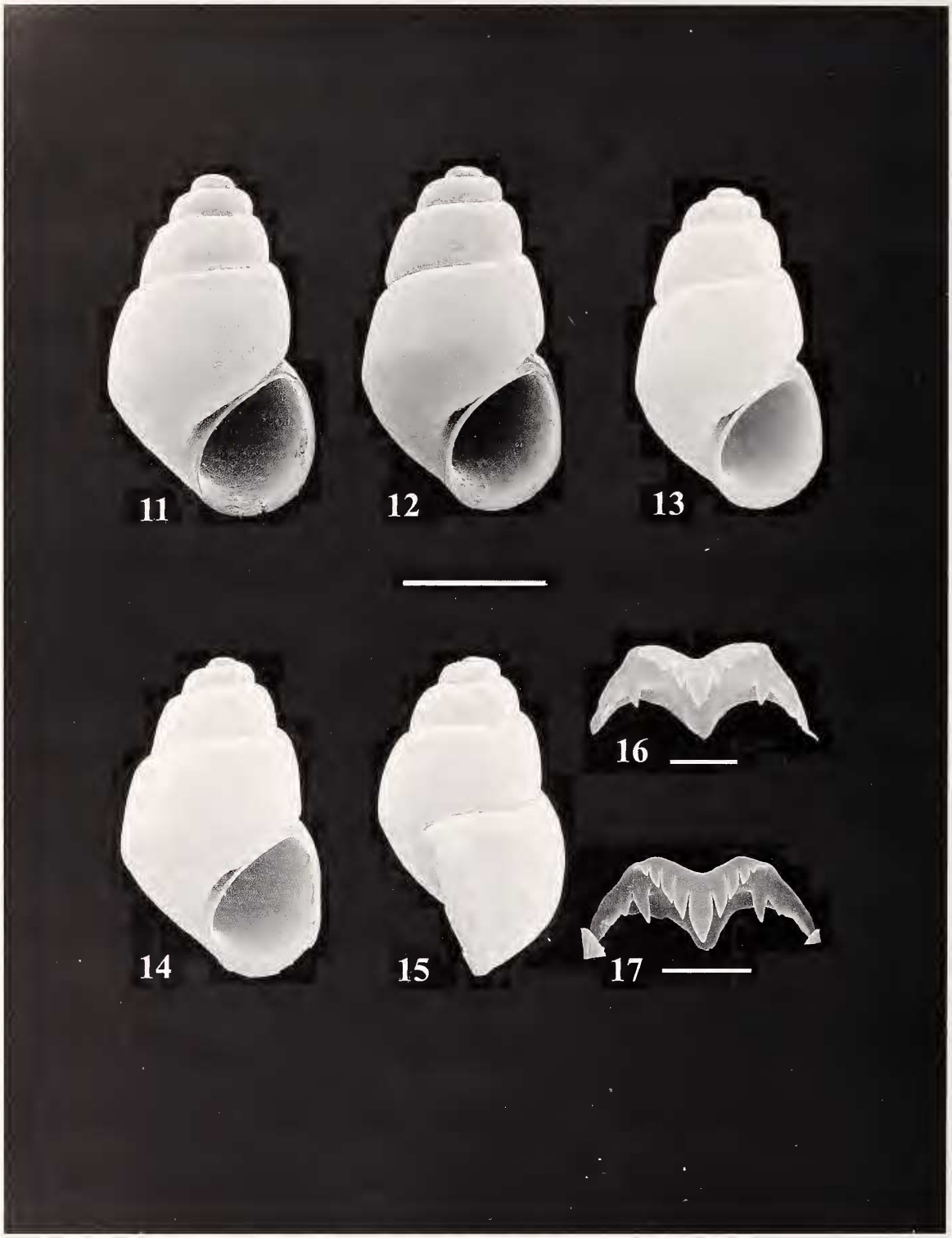
Distribution: The species in known only from the type locality. Numerous stream habitats were sampled in Laurens County and adjacent counties, but no other populations were found.

Habitat: This species was found on clumps of submerged mosses attached to roots of cypress (*Taxodium distichum*) and sweetgum (*Liquidambar styraciflua*) growing along the northeast edge of the pool next to the spring discharge. It was abundant during two occasions in which we visited the spring and was associated on the mosses with an equally abundant undescribed species of *Amnicola,* as well as with occasional specimens of *Physella hendersoni* (Clench, 1926).

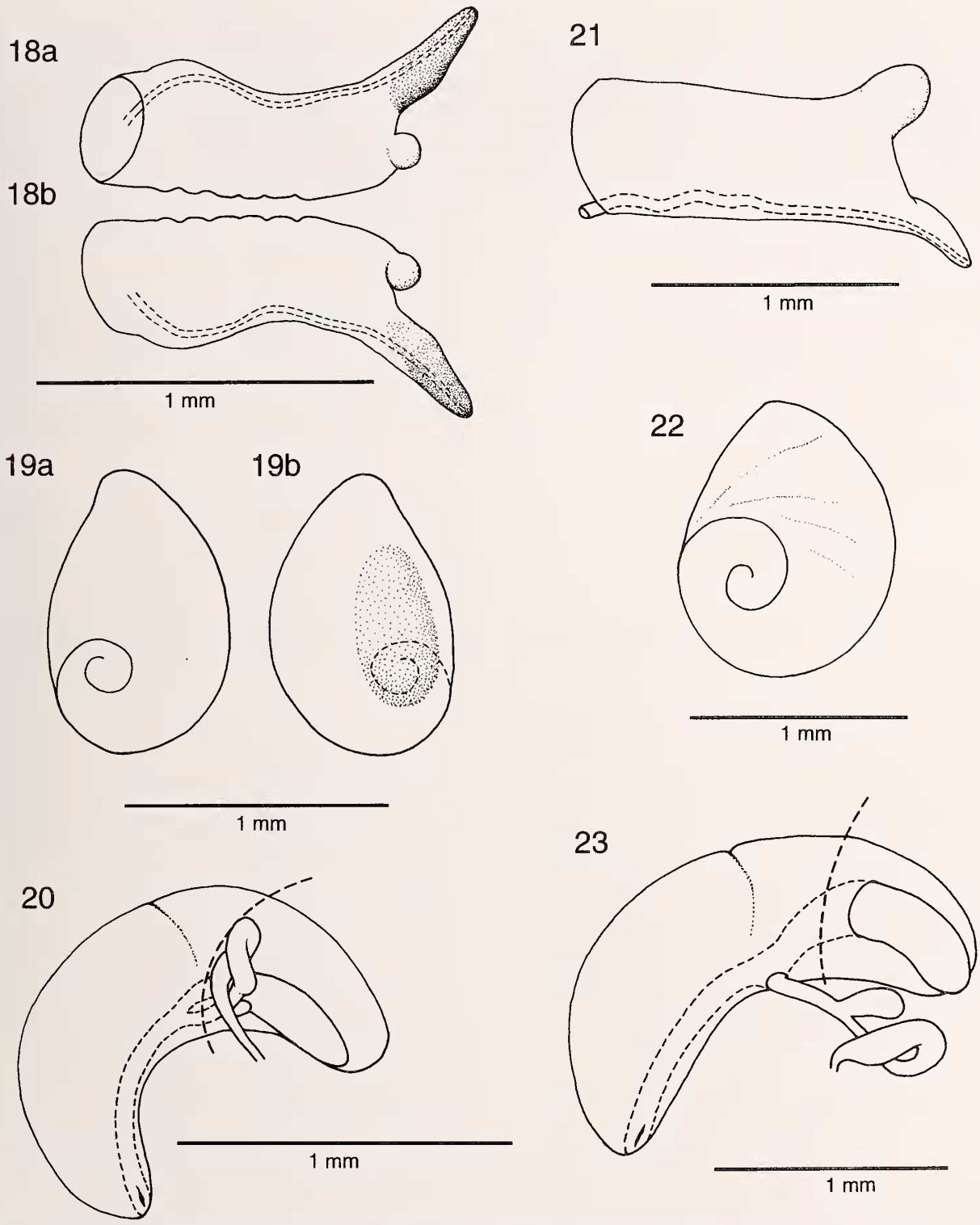
Remarks: The relationships of this species with the genus *Marstonia* are not clear. Penial morphology suggests a relationship with species of the central and the north-central United States. The shape of the penis and the arrangements of surficial glands on it is most similar to *M. lustrica* (Pilsbry, 1890), a species widely deployed in the north-central United States and adjacent Canada (Thompson, 1977). The ranges of the two species are disjunct by nearly 800 miles. *Marstonia lustrica* is a much larger species with a more elongate shell. In penial structures *Marstonia gaddisorum* also resembles *M. ogmorhaphe* Thompson, 1977, found in two springs in the Sequatchee River basin, a tributary of the Tennessee River in south-central Tennessee. *Marstonia ogmorhaphe* is a large spe-



Figures 3–10. SEM micrographs of *Marstonia* shell. Figures 3–8. ***Marstonia gaddisorum* sp. nov.**, PARATYPES (UF 306528). Figures 9, 10. ***Marstonia angulobasis* sp. nov.**, PARATYPE (UF 306527). Scale bars for Figures 3–9 = 1 mm. Scale bar for Figure 10 = 100 μm.



Figures 11–17. SEM micrographs of *Marstonia*. Figures 11–15. ***Marstonia angulobasis* sp. nov.**, PARATYPES (UF 306527). Figure 16. ***Marstonia gaddisorum* sp. nov.**, central tooth of radula (UF 266266). Figure 17. ***Marstonia angulobasis* sp. nov.**, central tooth of radula (UF 306081). Scale bar for shells = 1 mm. Scale bars for radula = 10 μm.



Figures 18–23. *Marstonia* anatomy. Figure 18. ***Marstonia augulobasis* sp. nov.**, penis: Figure 18a, inner view; Figure 18b, outer view. Figure 19. ***Marstonia angulobasis* sp. nov.**, operculum. Figure 20. ***Marstouia angulobasis* sp. nov.**, pallial oviduct. Figure 21. ***Marstonia gaddisorum* sp. nov.**, penis. Figure 22. ***Marstonia gaddisorum* sp. nov.**, operculum. Figure 23. ***Marstonia gaddisoruu* sp. nov.**, pallial oviduct with the oviduct separated from the albumen gland to show seminal receptacle. Scale bars = 1 mm.

Table 1

Shell measurements of two new species of *Marstonia*. *Marstonia gaddisorum* sp. nov. measurements based on the holotype (UF 26265) and fourteen paratypes (UF 267632) selected to show variation. *Marstonia angulobasis* sp. nov. Measurements based on the holotype (UF 263300) and eleven paratypes (UF 267634) selected to show variation. AH = aperture height, AW = aperture width, Wh = whorls, EWh = number of protoconch whorls, EW = diameter of first protoconch whorl, SL = standard length, SE = standard width, STD = standard deviation, Wh = whorls.

	SL	SW	AH	AW	Wh	EWh	EW	SW/SL	AH/SL	AW/AH	AW/SW
M gaddisorum											
Holotype	3.2	2.4	1.6	1.3	4.5	1.5	0.26	0.74	0.48	0.83	0.53
Paratypes											
Min.	2.8	2.1	1.4	1.1	4.1	—	—	0.68	0.40	0.78	0.48
Max	3.5	2.6	1.6	1.3	4.5	—	—	0.77	0.50	0.91	0.57
Avg.	3.26	2.41	1.45	1.24	4.34	—	—	0.74	0.45	0.85	0.52
STD	0.198	0.148	0.058	0.053	0.025	—	—	0.025	0.025	0.035	0.025
M. angulobasis											
Holotype	2.57	1.62	1.19	0.96	4.4	1.4	0.23	0.63	0.46	0.81	0.59
Paratypes											
Min.	2.11	1.32	0.96	0.79	4.2	1.2	0.22	0.58	0.39	0.79	0.52
Max	2.74	1.65	1.19	0.96	4.4	1.4	0.25	0.69	0.46	0.87	0.64
Avg.	2.37	1.49	1.04	0.85	4.35	1.35	0.23	0.63	0.44	0.82	0.57
STD	0.156	0.105	0.068	0.043	0.254	0.066	0.009	0.037	0.019	0.031	0.03

cies with a shell that is even more elongate than that of *M. lustrica* and the whorls are separated by a deeply impressed suture.

Among southern species *Marstonia gaddisorum* is most similar in shell appearance to *M. castor* Thompson, 1977, which is found in small creeks tributary to the Flint River in Crisp County, Georgia. *Marstonia castor* is a much smaller species, it is not as broadly conical, and the parietal margin of the operculum is concave. The penis is irregularly elongate in shape with a relatively longer and stouter filament. *Marstonia agarhecta* Thompson, 1969, from creeks entering the Ocmulgee River in Pulaski County, Georgia, also is smaller than *M. gaddisorum*. The peristome is incomplete across the parietal wall, and the parietal margin of the operculum is concave. The penis is very slender with a relatively large apical lobe bearing a large apocrine gland, the filament also is long and stout and the ventral side has a small apocrine gland near its middle raised on a low pedicel. *Marstonia halcyon* Thompson, 1977, from the Ogeechee River in southeastern Georgia is similar in size, but is more broadly conical, the whorls are noticeably shouldered compared to *M. gaddisorum,* and they tend to be flattened on the side. The operculum is concave along the parietal margin. The penis is very slender with an elongate apical lobe and filament. It too has a small apocrine gland on the ventral surface near the middle raised on a small pedicel.

Marstonia gaddisorum occurs with a similar-appearing species of *Amnicola*. Live speciments of the latter snail are readily distinguished by having a nearly black head-nape and a single broad black stripe along the tentacle.

Etymology: This snail is named for Richard Marshall Gaddis and his wife Emily Gaddis, who provided field assistance at the time this snail was discovered. Richard Gaddis is known for his work in entomology.

Marstonia angulobasis sp. nov.

Diagnosis: A species distinguished by its minute size of up to 2.5 mm in length, slender, elongate in shape with an aperture that is less than half the length of the shell, and flatted whorls that are bordered at the periphery by a distinct angle or cord. The penis bears a terminal small apocrine gland, and has a long slender filament that is about half the length of the penis.

Shell (Figures 2, 9–10, 11–15): Shell very small, 2.11–2.53 mm in length; slender, 0.58–0.69 times as wide as long. Light gray. Spire compactly coiled; nearly straight-sided, being weakly convex in outline and with a sharply impressed suture. Whorls 4.1–4.4, conspicuously shouldered, nearly flat-sided and bearing pronounced peripheral angle which sometimes forms peripheral cord along last half whorl. Base of last whorl below periphery nearly flat to weakly rounded. Protoconch raised but flat-topped. First whorl 0.22–0.25 mm in diameter perpendicular to initial suture. First half whorl sculpture with irregular wavy micro-wrinkles (Figure 10). Subsequent whorls, smooth with occasional barely discernable incremental striations. Umbilical perforation narrow but distinct. Shell wall very thick for its size (Figure 9); about 80 μm thick at periphery of last whorl. Aperture ovate; about 0.79–0.87 times as wide as high; 0.39–0.46 times length of

shell. Peristome complete across parietal wall, parietal margin nearly straight, columellar margin uniformly indented, straight-edged. Plane of aperture vertical in lateral profile. Outer lip weakly but distinctly reverse-sigmoid in lateral view; slightly indented below shoulder and below periphery (Figure 15).

Operculum (Figure 19): Thin, hyaline, elliptical–ovate in shape. Nucleus located about a fourth of the distance from the base to the apex, and about a third of the distance from the columellar margin to the outer edge. Parietal margin indented.

Radula: N = 1. Central tooth (Figure 17) longate-rectangular in shape; lateral angle well developed; basal process narrow; dorsal edge deeply indented; mesocone pointed and lanceolate in shape, with 4 ectocones on each side; lateral process of tooth with a single well developed and 1–2 additional weakly developed basocones. Lateral tooth with 3-1-4 cusps. Inner marginal tooth with 14 cusps. Outer marginal with 17 long acuminate cusps.

Animal: The head-foot is uniformly pale. Most specimens have a narrow, dark pigmented margin along the opercular lobe. The mantel collar usually is strongly pigmented with melanophores. The pallial roof, stomach and visceral coil usually are covered with diffuse dark pigment. In some specimens the pigment may be reduced to isolated blotches, or be entirely absent. The ctenidium has 24 lamellae (n = 1).

Male (Figure 18): The penis is relatively slender and nearly uniform in width with a slight bulge along the outer margin near the base. The relatively stout penis filament extends far beyond the apex of the penis, and is almost half of the penis length. The filament varies from opaque white to dark gray. It tapers uniformly and ends in a blunt tip. It does not bear external glands. The vas deferens is slender and courses along the outer margin of the penis to the apex of the filament. The penis bears a single small apocrine gland on its distal tip. The gland is circular and is partially set off from the penis by being conspicuously constricted around its base.

Female (Figure 20): The oviduct coil consists of a single twisted loop. The seminal receptacle is small and papilliform, and is imbedded in the albumen gland ventral to the oviduct coil. The elongate, saccular bursa copulatrix extends to the end of the albumen gland. Its posterior half is exposed along the mesad surface of the albumen gland. The anterior half is imbedded and unites with the oviduct anterior to the body wall.

Type locality: ALABAMA, Madison County, Tennessee River drainage, Paint Rock River, ca. 0.7 miles (1.1 km) east of Cedar Point Village, 34°35.9′N, 86°19.4′W. HOLOTYPE: UF 263300; collected 1 September, 1996 by Fred G. Thompson, Harry G. Lee and Henry McCullagh. PARATYPES: UF 267634, UF 306081 (SEM radula) UF 306527 (SEM shell specimens); same data as the holotype.

Other specimens examined: ALABAMA: Madison County, rocky shoals in Paint Rock River, ca. 0.5 miles (0.8 km) upstream from Butler Mill, 34°34.9′N, 86°18.4′W (UF 263317); Paint Rock River 4.6 miles (7.4 km) N of Estillfork, 34°57.9′N, 86°09.2′W (UF 263289).

Distribution: This species is known only from Paint Rock River from north of Estillfork near the Tennessee border, south to Butler Mill, near the Tennessee River.

Habitat: At the type locality snails were collected in a section where the river passes through a narrow gap between limestone outcrops. Snails were found only on aquatic bryophytes growing on limestone in the faster current. This species was found in a similar habitat farther downstream near Butler Mill. At the locality north of Estillfork specimens were unnoticed in the field among other hydrobiids that were collected from various microhabitats.

On several occasions between 1970–1996 I had collected mollusks in Paint Rock River. This species was overlooked on previous surveys because of its very small size and its restricted microhabitat. In September, 1996 Harry G. Lee, Henry McCullagh, and I conducted a survey of the river by canoe, which allowed us to sample microhabitats that are not available at most places easily accessible by roads.

Remarks: This is the smallest species of fluviatile snail known from the Tennessee River system. It is rivaled in its small size among eastern fluviatile snails only by *Marstonia agarhecta* Thompson, 1970, and *M. castor* Thompson, 1977. In features of shell shape it is similar to *Marstonia scalariformis* (Wolf, 1869), which is a much larger species (Hershler, 1994:80–81).

Etymology: The name *angulobasis* is from the Latin *angulus*, an angle, and *basis*, a foundation or base. The name alludes to the distinct subperipheral angle around the last whorl.

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